In-Situ "Green" Groundwater Treatment Design and Engineering of Controlled Vertical Hydraulically Fractured GW Remediation Programs

Kevin D. Dyson, P.E. – Geosierra Environmental, Inc., Medford, New Jersey

Across much of the United States, ground water supplies are either diminishing due to extended drought and aquifer overpumping conditions, or are severely impacted due to historical industrial activities. Preservation of existing water supplies or remediation of existing impacted water sources is critical to the continued growth and security of the United States over the coming decades. One method for protecting or remediating impacted water supplies is through emplacement of reactive media for either source groundwater remediation, elimination of offsite contaminant migration with property boundary reactive barriers or enhancement of existing extraction technologies. Emplacement of reactive media within the subsurface eliminates the need for highly inefficient remedial processes such as pump-and-treat or air sparge/soil vapor extraction systems or dramatically increases their effectiveness, reducing life cycle operating timeframes and enabling clean groundwater fronts to be established much faster. Extraction systems typically consume significant quantities of local groundwater and energy resources, and typically only treat a small percentage of the overall contaminant mass present while not achieving to goal of contaminant destruction. Rising energy costs in addition to depleted groundwater systems have resulted in passive, "green" and extremely efficient contaminant reduction mechanism such as reactive media emplacement with *controlled* vertical hydraulic fracturing to be more commonly accepted and implemented around the country.

As opposed to current practices of uncontrolled horizontal hydraulic fracturing that relies on an "inject-and-pray" scenario, a method has been commercialized that allows controlled emplacement of reactive media in a vertical orientation along an intended azimuth bearing to can serve as a continuous barrier. Vertical emplacement allows installation of reactive media such as iron filings, or permeability enhancement materials such as sand, ceramic beads, etc. to directly treat groundwater contamination or dramatically increase the efficiency of existing extraction technologies. The goal of this session will be to describe and detail the engineering design of a controlled vertical hydraulically fractured barrier system for emplacement of zero valent iron at a downgradient property boundary, and detail the use of the technology for source area remediation programs. Elements of the stepwise process design include:

- Flow Through Column Testing
- GW Aquifer Characterization with Hydraulic Pulse Interference Testing
- Monte Carlo Probabilistic Design Simulations and Geochemical Modeling Scenarios
- Hydraulic Fracturing Mechanics and 2-Dimensional Modeling
- Proppant Gradation Design
- Site Specific Fracture Gel Design
- Emplacement Quality Assurance/Quality Control
- Example Reactive Barrier Construction
- Applications of Vertical Hydraulic Fracturing for Source Area Treatment